ITER PFC Research Needs

(Including those beyond US contribution)

December 7, 2004

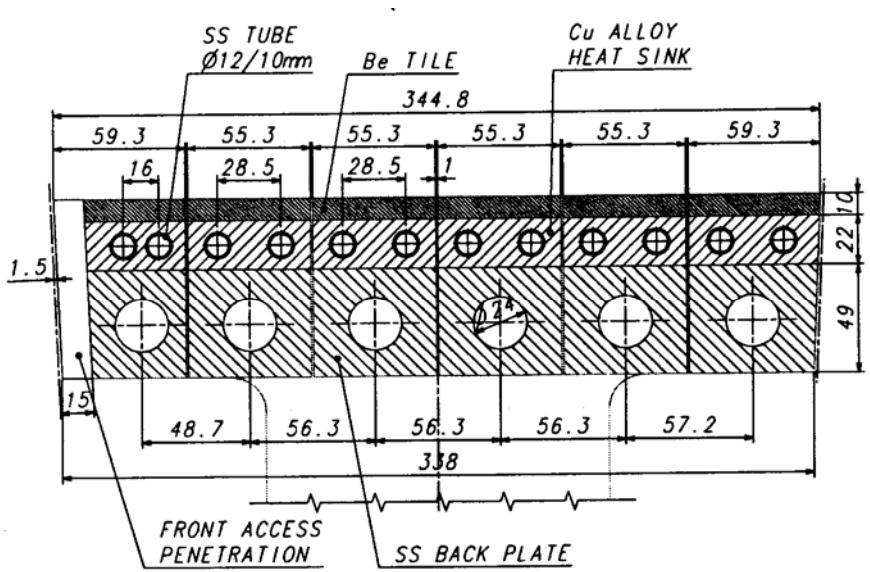
M. Ulrickson
Presented at PFC Technology Meeting
Livermore, CA

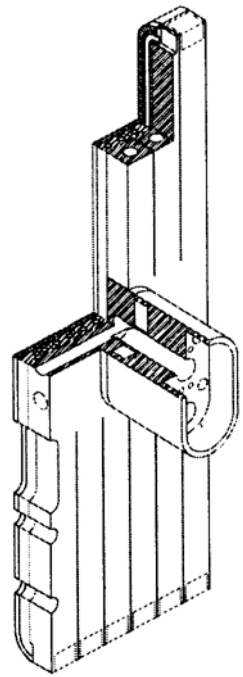
Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

Outline

- First Wall Shield Module 18
  - Be joining to Cu alloy
  - Cu alloy joining to 316 stainless steel
  - Fabrication of large water cooled 316 components
  - Control of eddy currents in FW/S structures
- Other research issues
  - Understanding and control of Tritium retention
  - Erosion of the first wall
  - Understanding the effect of ELMs on PFCs
  - Preparation for Test Blanket Module

ITER FW Design

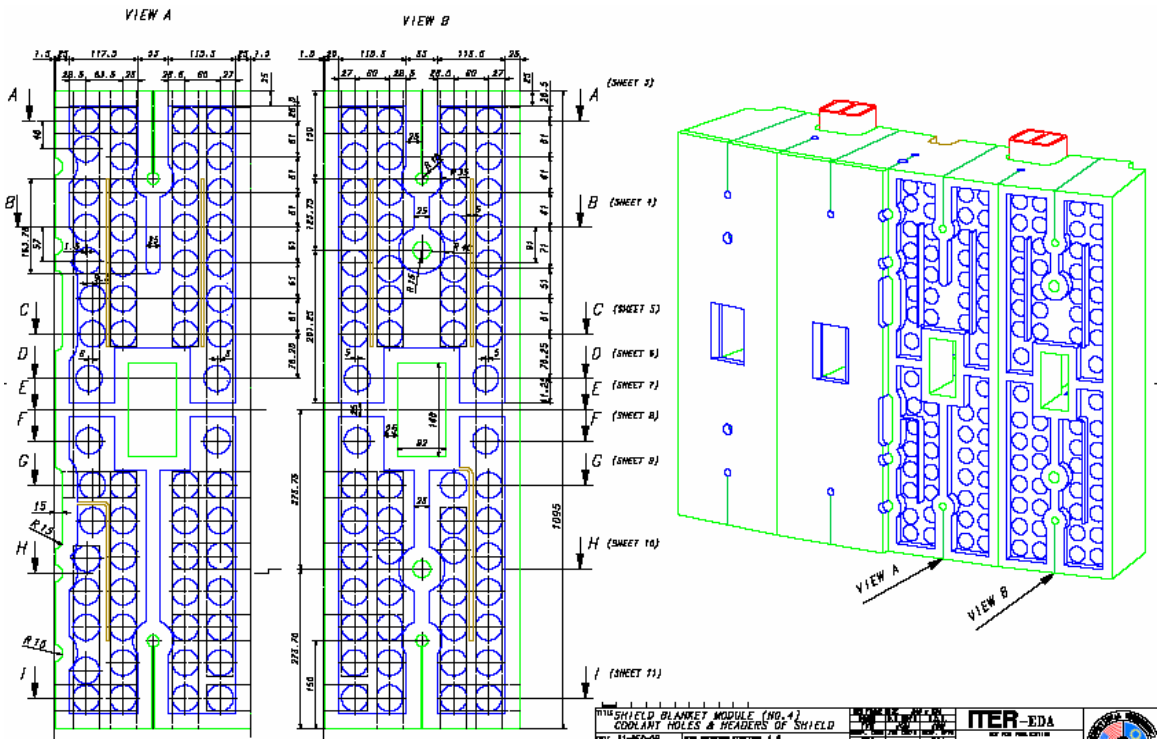




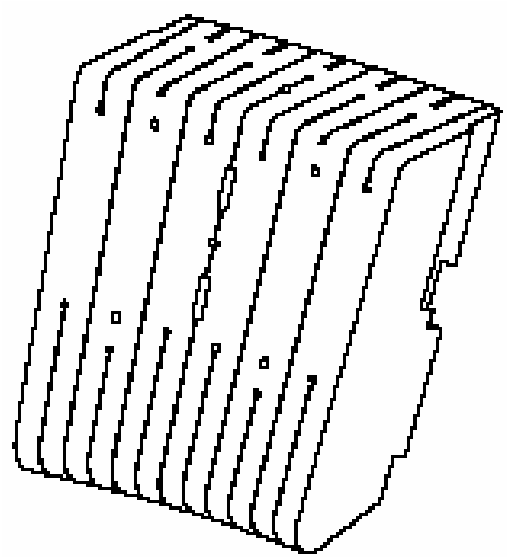
Plasma Sprayed
FW Mockup

Sandia National Laboratories

ITER Shield Module Design



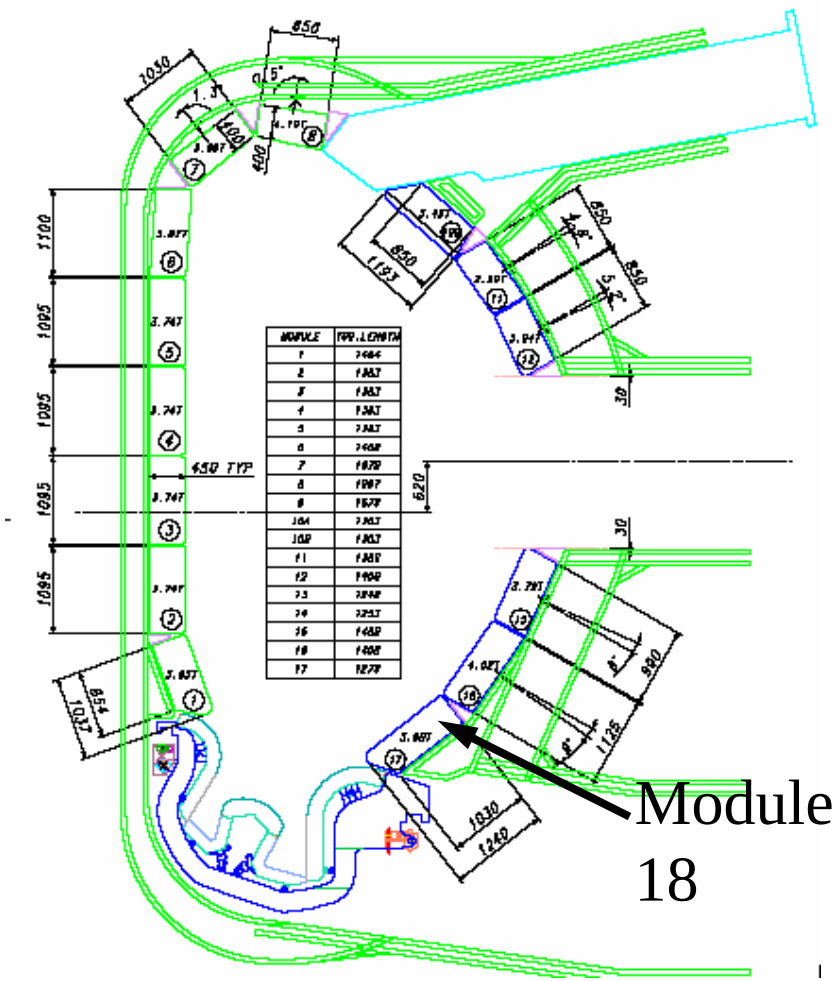
Generic Module Design



Old Module 18 Concept

Sandia National Laboratories

ITER First Wall Design



Sandia National Laboratories

Summary of FW/S Issues

- The FW design requires Be joined to Cu in a very tight space (high heat flux capable)
- Cu alloy must the joined to 316 without ruining the properties of the Cu alloy (EDA solved?)
- Complicated 316 structures must be fabricated inexpensively

Other Issues

- The mechanisms of carbon erosion, transport and deposition are not well understood (even ignoring mixed materials)
- Removal of T from C deposits can probably be done from exposed surfaces (not hidden ones)
- The role of “blob” transport in first wall erosion is just beginning to be studied.
- Transport of eroded material is poorly understood (everything goes to the inner divertor in single null?)
- Erosion generates dust (possible impurity source)
- Mixed materials complicate (and may alleviate) many issues

Other Issues

- ELMs are high cycle fatigue and erosion issues and there is no data at large numbers of cycles
- The proper operating temperature is crucial
- Fatigue at less than melting energy deposition may enhance erosion